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**Soil,
Crops,
and**

FALLOUT
from
**NUCLEAR
ATTACK**



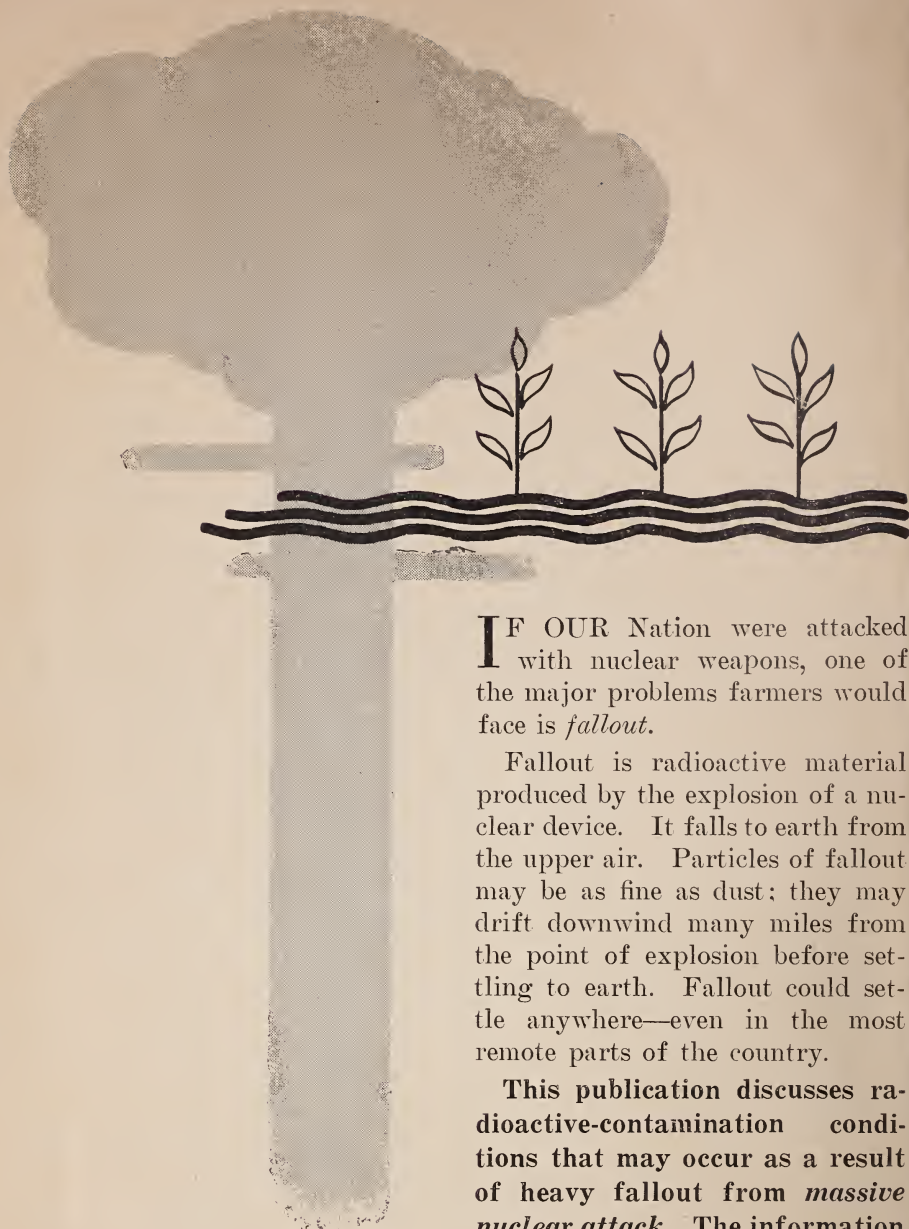
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IF OUR Nation were attacked with nuclear weapons, one of the major problems farmers would face is *fallout*.

Fallout is radioactive material produced by the explosion of a nuclear device. It falls to earth from the upper air. Particles of fallout may be as fine as dust; they may drift downwind many miles from the point of explosion before settling to earth. Fallout could settle anywhere—even in the most remote parts of the country.

This publication discusses radioactive-contamination conditions that may occur as a result of heavy fallout from *massive nuclear attack*. The information given here is *not related in any way* to conditions that result from distant, controlled *testing* of nuclear devices.

In nuclear warfare, massive fallout from a nuclear explosion could

Soil, Crops, and FALLOUT from NUCLEAR ATTACK

emit radiation that would injure or kill humans and animals. In sufficient quantities, such fallout could also make food, water, buildings, farmlands, and crops unsafe¹ for use for varying periods of time.

If a massive nuclear attack were to occur, a high percentage of our farmland would receive heavy *early* fallout. Almost every part of the country would receive varying amounts of *delayed* fallout. Early fallout is that which is deposited during a short time after a nuclear explosion, and relatively near the point of explosion. Delayed fallout is that which usually is carried

by the winds and falls to earth over a much longer period of time and over far wider areas.

In areas receiving heavy, early fallout, the farming procedures would need to be drastically altered until these areas and their soils were safe for normal use. In most areas receiving light, delayed fallout, farming could continue as usual; crops and other farm products would be only slightly affected.

¹ "Unsafe" as used in this publication means that, based on all presently available research, the object described contains sufficient radioactivity to cause serious external or internal radiation damage to humans or animals.

DURATION OF CONTAMINATION

The length of time fallout would affect the soil and crops would depend on the amount and type of radioactive materials in the fallout. Generally, after several weeks following a nuclear attack, *external* radiation (from radioactive materials outside the body) would not be hazardous. This is because of decay of radioactivity in fallout.

However, there are present in fallout a number of radioactive elements including strontium that are

very long-lived. Strontium could contaminate soils and plants for decades. It is chemically similar to calcium. It would be absorbed by and would contaminate plants, particularly those growing in calcium-deficient soils.

Persons or animals consuming food or water contaminated with radioactive materials would be subject to *internal* radiation (from radioactive materials inside the body, which have been ingested, inhaled, or absorbed).

MONITORING DEVICES

If fallout occurs in your area following a nuclear attack, you will be informed on the general hazards by local civil defense authorities. These authorities can now give you information regarding monitoring devices that you may purchase to measure radiation levels of various parts of your property and of materials. The proper monitoring device would indicate the areas where radiation levels are too high for you to be safely exposed to them.

FARM FALLOUT PROBLEMS

Fallout from nuclear attack would pose two basic problems in farming areas: (1) To protect yourself, family, and workers from exposure to external radiation, and (2) to produce food that could be consumed without danger of internal radiation injury.

Personal protection.—For personal protection, observe the following rules:

- Do not cultivate or work in areas contaminated with fresh fallout until advised by your local civil defense authorities that it is safe to do so. Follow the work schedules and exposure restrictions that, in an emergency, will be prescribed by these authorities.

- When working in contaminated areas, wear protective clothing—hat, coat, boots, and gloves. If you are plowing or cultivating dry

land, or if you are harvesting crops, wear a dust filter over your nose and mouth if these operations are dusty.

Production of safe food.—It is not expected that you could raise entirely uncontaminated crops in contaminated soil. The objectives are (1) to reduce soil contamination as much as is practicable, and (2) to raise crops in which the absorbed contamination is so slight that danger of internal radiation injury is minimized.



THE SOIL AND FALLOUT

Highly Contaminated Soil

Agricultural land should not be subjected to drastic decontamination measures until it has been seriously contaminated with strontium 90.

Neither special remedial measures nor unusual modifications of normal practices should be introduced, however, until responsible authorities have declared that a state of emergency exists, making some kind of decontamination measures advantageous or necessary.

Decisions concerning the application of drastic measures might be difficult to make. They would be based on balancing medical assessments of probable damage from radiation against the resulting reduction in available food supplies, and the cost, and the economic and social dislocations that would be caused by such measures.

If the soil were highly contaminated, you might be advised to take it out of production for an indefinite period until the radioactivity decayed to a safe level. Such soil can be decontaminated, but the procedures are severe and expensive—for example, deep plowing, or

scraping off the contaminated top surface. These procedures are not suitable for large areas, but could be useful if small areas were required to produce food for the survival of people.

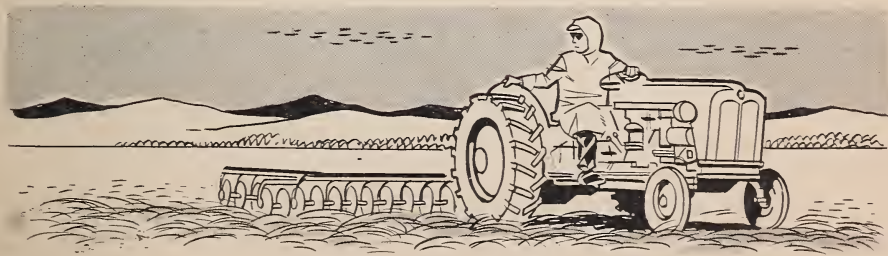
Less-Contaminated Soil

Soils that are not too highly contaminated may be treated to reduce the amount of radioactive material that will be absorbed by the crops. The most effective treatments are *liming and fertilizing*, and *removal of contaminated vegetation and mulch*.

Liming and Fertilizing

If your soil normally requires lime and fertilizer for optimal yields, the same applications are recommended to reduce the uptake of radioactive strontium by the growing crops. If adequate amounts of lime and fertilizer are applied to acid or infertile soils, the amount of soil-derived radioactive strontium taken up by the plants might be reduced by as much as two-thirds.

If your soil is highly fertile, and is neutral or alkaline, the application of lime fertilizer would have



little or no effect in reducing a crop's uptake of strontium 90.

Your county agent or State agricultural officials will recommend the amount of lime to use per acre. The limestone should be finely ground so it will react quickly to the soil. On cultivated land, it should be broadcast uniformly and thoroughly disked or plowed into the soil.

For most soils, lime should not be applied in excess of the amount needed for optimal plant growth. In the production of small cereal grains, however, addition of *more* lime than is needed for best growth may be helpful in reducing the uptake of radioactive strontium without reducing crop quality or yield.

Application of lime to the surfaces of established pastures increases the calcium content of the vegetation and lowers the strontium content.

For further information on the use of lime, see Farmers' Bulletin 2124, "Liming Soils."

Removal of Contaminated Vegetation and Mulch

After the initial fallout has ended, standing grain or cultivated crops probably would retain 10 to 30 percent of the radioactive deposit. These contaminated crops could be removed rapidly with conventional forage-harvesting equipment.

Surface mulches form a cover that might retain up to 90 percent of the fallout; the amount would depend on the thickness of the mulch, moisture content, distance from the point of explosion, and other factors. To be effective as a protective cover, however, mulching material *must be in place at the time a heavy deposit of fallout occurs*. The retained contamination could be removed by cutting and removing the crop or mulch with a rake or windrow device.

Safe disposal of contaminated mulch or crop residues is important. The bulk may be reduced by baling; or the material may be burned so as to conserve the ashes, which would contain the radioactive strontium. The concentrated contaminated material should be buried in a place unlikely to be disturbed by water movement.

Soil Contamination by Irrigation Water

Irrigation water would add relatively little radioactive contamination to croplands. Most of the contaminants would be absorbed by the soil of the banks and bottoms of lakes and streams. They would be subsequently absorbed further by irrigation canal linings and ditch banks.

Contamination of soil and direct contamination of crops, however, might be a hazard from sprinkler irrigation with contaminated water from lakes, streams, or ponds.

CROPS AND FALLOUT

After fallout has ended, your first consideration would be to reclaim the harvested food and feed crops that can be made safely edible through decontamination or through delay in handling or marketing. Such delay would allow the short-lived radioactive materials to decay. You and your family might need some of the crops as food. The second consideration would be to get the land back into production. This might necessitate changing to crops different from those you are accustomed to raising.

Decontaminating Harvested Crops

If fallout particles get on food or feed, there are several possible methods of decontamination. Often the radioactive particles can be removed in the same way as any other dust—by washing, vacuum cleaning, or brushing.

If uncovered supplies become contaminated, usually only the top parts are affected; these parts could be removed, and the underneath parts would be usable.

Many food products should be stored long enough to allow radioactivity to decay to a safe level. Cooking does not destroy radioactivity.

Contaminated potatoes and other root crops would be safe to use after washing and peeling. Peas and beans could be washed, shelled, and

used. Apples, head lettuce, cabbage, sweet corn, and other foods would be usable if thoroughly washed to remove surface contamination and then peeled or the outside otherwise removed.

Changing to Different Crops

Your soil might be contaminated at a level unsafe for some crops but safe for others. Then, you may be able to keep the land in production by changing to different types of crops—usually to crops that have a low-calcium content.

Potatoes would be a suitable substitute crop because they would absorb very little radioactive strontium compared with leafy vegetables. Corn, sugar, and oil crops utilize less calcium and can be substituted on land too heavily contaminated to produce other food crops. Crops that produce high-calcium foods should be grown on the less-contaminated land.

Nonfood crops could be substituted for food or feed crops. You might grow cotton, fiber, castor beans, timber, or other such crops.

Land that is unsafe for dairying or food crops might be put into pasture for the production of beef or other meat. The radioactive strontium retained by animals grazing contaminated pastures or eating contaminated hay goes mostly into the bones. Therefore, meat produced on contaminated land could be boned and used for food, within prescribed limits.

FAMILY FALLOUT PROTECTION

In the event of enemy attack, first provide for your own safety and that of your family and neighbors. To do this, you may not be able, at first, to take care of your livestock, your crops, and your land.

Your best protection from fallout is a specially constructed shelter. Designs of eight types of family fallout shelters, including "do-it-yourself" types, are presented in a publication titled "Family Shelter Designs", H-7, available from your local civil defense office, or by mail from Office of Civil Defense, Department of Defense, Washington 25, D.C.

If there is a civil defense emergency and you have not yet built a special shelter, go to the safest place you have. This may be a cyclone cellar, a root cellar, or a corner of your basement. Shield

doors, windows, and other openings with dense materials such as concrete blocks, bricks, or sandbags if you have them.

If you do not have an underground refuge, stay indoors. Covering the floor above with sandbags or loose soil would be helpful. Shield yourself with as much dense material as possible.

Local civil defense authorities will make every effort to let you know when it is safe to come out of shelter. Emergency information will be disseminated to the public in every possible way, including your radio.

For additional information on family protection from the effects of nuclear fallout, contact your local civil defense office or the Office of Civil Defense, Department of Defense, Washington 25, D.C.

This publication was prepared by the U.S. Department of Agriculture in cooperation with the Atomic Energy Commission, the Office of Civil Defense of the Department of Defense, and the U.S. Public Health Service.